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# The Effects of Supplemental Instruction on Student Achievement in College Algebra

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# THE EFFECTS OF SUPPLEMENTAL INSTRUCTION ON STUDENT ACHIEVEMENT IN COLLEGE ALGEBRA

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## ABSTRACT

College Algebra consistently has a very high number of students performing poorly. An experimental study addressing student performance was conducted. Two College Algebra classes each with 25 students and with the same teacher were used, one as the control group and the other as the experimental group. The experimental class included mandatory Supplemental instruction (SI) for an extra class period per week. T-tests were used to compare performances on each test and homework. A Repeated Measures 2x2 ANOVA was used to compare the students' performance on a pre-test and a post-test between each class. The Mann-Whitney U-test was used to compare final grade distributions. The results of the T-tests were not significantly different. The results of Repeated Measures 2x2 ANOVA indicate that there was not a significant difference between the two classes' performance. Finally, the Mann-Whitney U-test showed that there was not a significant difference between the final grade distributions.

***Key Words:*** mathematics, supplemental instruction, student achievement, college algebra

## INTRODUCTION

Mathematics has traditionally been a course that causes a lot of emotions. Students love it, hate it, or fear it. At the university level, College Algebra is a required course for all students. Traditionally, the course is taken by first time incoming freshman. Currently, about 20 sections of College Algebra are offered each fall semester. Albany State University (ASU) is a public, historically black comprehensive university located in rural southwest Georgia, with an enrollment of approximately 4000 students. College Algebra has

 

one of the highest "non-passing" rates at ASU (Bynum, Heglar, Hill, Jones, Leggett, Okonkwo, Qawiy, Whitley, & Wooden, 2008). Thus, actions have been taken to improve student performance in this "Killer Course." These actions include supplemental instruction (SI), peer tutoring in the Department of Mathematics & Computer Science, and general peer tutoring offered by the university. Required or mandatory Supplemental Instruction is the focus of this research.

## REVIEW OF LITERATURE

Supplemental instruction (SI) is a type of student assistance whose goal is to promote student success in traditionally difficult courses. SI was originally developed by Deanna Martin at the University of Missouri-Kansas City (UMKC) in 1973 (Lazari & Simons, 2003). Bowles, McCoy, and Bates (2008) and McQuire (2006) attest to the success of SI and the fact that SI is learner centered. This represents the current paradigm shift in colleges and universities from teacher to student. Currently, SI has been implemented in more than 50 universities nationwide. The International Center for Supplemental Instruction at the University of Missouri-Kansas City defines the program as "a peer facilitated academic support program that targets historically difficult courses so as to improve student performance and retention by offering regularly scheduled, out-of-class review sessions" (University of Missouri-Kansas City, 2008). A review of the literature on the effectiveness of supplemental instruction has indicated mixed results (Bowles, McCoy, and Bates, 2008; Mays, Chase, & Walker, 2008; McQuire, 2006). Subject matter also plays a part in the ambiguity of the data results. Subject areas using supplemental instruction include the natural sciences as well as mathematics.

In an effort to improve students' performance in College Algebra, Supplemental instruction was introduced at Albany State University several years ago (Bynum et al, 2008). The format consisted of an instructor providing additional instruction and help to students two nights per week for two hours per night. The goals of ASU's supplemental instruction are to improve grades, retention, professionalism, and graduation rates. Students' attendance was strictly voluntary. Voluntary attendance resulted in very little participation in SI. Students who needed the additional help seldom sought after such help. Thus, this study poses to determine if requiring students to attend supplemental instruction by incorporating it into their College Algebra Course will increase academic achievement. The College Algebra course at ASU is consistent with the expectations of the University System of Georgia. It is a 3 hour course addressing college algebra entry level topics.

## METHOD

In order to address the research question, a control group/experimental group design was utilized. Two Algebra classes having the same teacher and the same number of students were used, one as the control group and the other as the experimental group. The experimental class was altered to

include a mandatory lab component (SI) for an extra class period per week. Thus, instead of meeting 3 days per week for 50 minutes each day, this experimental class met 4 days per week for 50 minutes each day. The SI class was still a 3 credit hour course during registration. Registering for the experimental course was strictly voluntary. Both classes were given a pre-test, 5 in class tests, and a post-test, along with 8 homework assignments. The pre-test and the post-test assess the same objectives, the objectives covered in college algebra. A T-test was used to compare the performance on each test given to both classes and each homework assignment. A 2 x 2 Repeated Measures ANOVA was used to compare pre-test to post-test against the two classes, one with the required SI and one without the required SI. Finally, a Mann-Whitney U-test was used to determine if a significant difference existed between the final grade distributions between the two classes. The significant level used throughout the research is less that .05.

Due to the nature of this scenario, a quasi-experimental design was employed primarily because the classes were considered to be intact groups. Again, registration for the courses was strictly voluntary (Campbell & Stanley, 1963; Patten, 2007). The researcher/teacher had to use the available classes for the study. In order to compensate for non-random assignment of students to the control and experimental classes, the pretest was used to determine if the classes were comparable at the outset.

## RESULTS

The results of this study were gathered from two college algebra classes with 25 students in each. Both classes retained all students from pretest to posttest. Data were collected from students' performance on tests, homework assignments, and final grades.

The averages for the 8 homework assignments for the class with the lab are 96 (SD=7), 76 (SD=25), 67(SD=36), 58(SD=40), 72(SD=37), 54(SD=46), 86 (SD=30), and 72 (SD=31). The averages for the homework assignments for the class without the lab are 91 (SD=22), 72(SD=31), 73(SD=32), 53(SD=44), 72(SD=42), 46(SD=44), 74(SD=39), and 69 (SD=41). The averages on the pre-test, 5 class tests, and post-test for the class with the lab are 25 (SD=9), 63(SD=14), 64(SD=21), 62(SD=14), 65(SD=23), 40(SD=26), and 57(SD=25). The averages for the class without the lab are 28 (SD=8), 68 (SD=15), 60(SD=23), 62 (SD=15), 69 (SD=15), 49 (SD=24), and 68 (SD=25). The results of all statistical tests indicated no significant difference. See Table 1 and Figures 1 and 2. A Repeated Measures 2x2 ANOVA was used to compare the classes on the pre-test and then post-test. The averages on the Pre-test and post-test for the class with the lab are 25 (SD=9) and 57 (SD=25) respectively, without the lab are 28 (SD=8) and 68 (SD=25). The results were $F=2.651$, $p=.110$ and $F=101.279$, $p=.000$. The first set of results ($F=2.651$, $p=.110$) indicate that there was no significant difference between the two classes' performance from pre-test to post test, but the second set of results ($F=101.279$, $p=.000$) indicate that there was a significant difference

within both classes from pre-test to post-test. Thus, both classes improved at about the same level. The final grade distribution for the class with the lab is As-1, B's-5, C's-10, D's-1, and F's-8; without the lab, A's-2, B's-5, C's-11, D's 3, and F's-4. See Figure 3. Analysis with the Mann-Whitney test results were U=294, p=.539. This suggests that there was no significant difference between the two classes' final grade distribution.

***Table I.*** Comparison of Tests and Homeworks with Statistics.

| Assignment | Class with SI Mean | Class with SI Standard Deviation | Class W/O SI Mean | Class W/O SI Standard Deviation | *t* | Significance Level | Significant |
|---|---|---|---|---|---|---|---|
| Pre-Test | 25 | 9 | 28 | 8 | 1.188 | .241 | No |
| Test 1 | 63 | 14 | 68 | 15 | 1.107 | .274 | No |
| Test 2 | 64 | 21 | 60 | 23 | -.618 | .540 | No |
| Test 3 | 62 | 14 | 62 | 15 | -.050 | .960 | No |
| Test 4 | 65 | 23 | 69 | 15 | .708 | .483 | No |
| Test 5 | 40 | 26 | 49 | 24 | 1.216 | .231 | No |
| Final-Test 6 | 57 | 25 | 68 | 25 | 1.575 | .122 | No |
| Homework 1 | 96 | 7 | 91 | 22 | -.992 | .327 | No |
| Homework 2 | 76 | 25 | 72 | 31 | -.577 | .567 | No |
| Homework 3 | 67 | 36 | 73 | 32 | .638 | .526 | No |
| Homework 4 | 58 | 40 | 53 | 44 | -.477 | .635 | No |
| Homework 5 | 72 | 37 | 72 | 42 | .050 | .960 | No |
| Homework 6 | 54 | 46 | 46 | 44 | -.585 | .562 | No |
| Homework 7 | 86 | 30 | 74 | 39 | -1.087 | .283 | No |
| Homework 8 | 72 | 31 | 69 | 41 | -.309 | .759 | No |

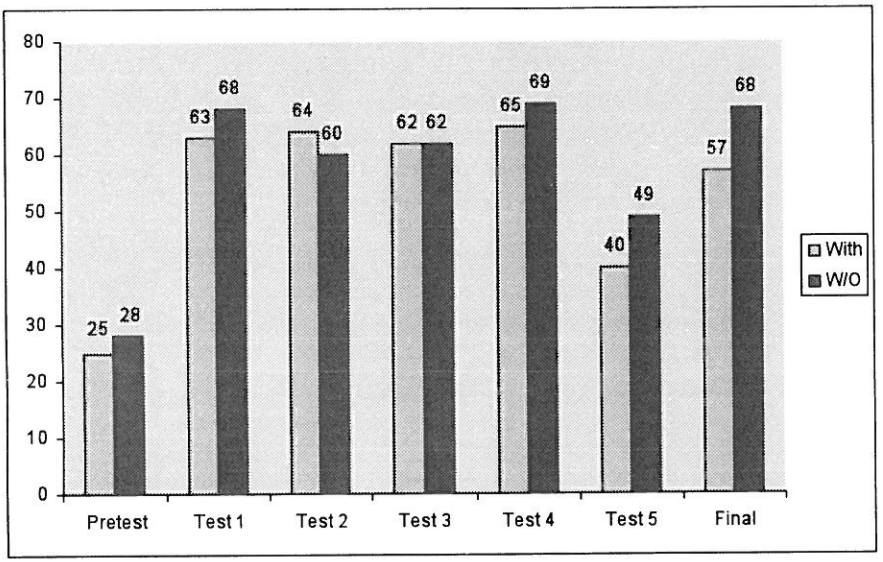


***Figure 1.*** Comparison of Test Grades Means.

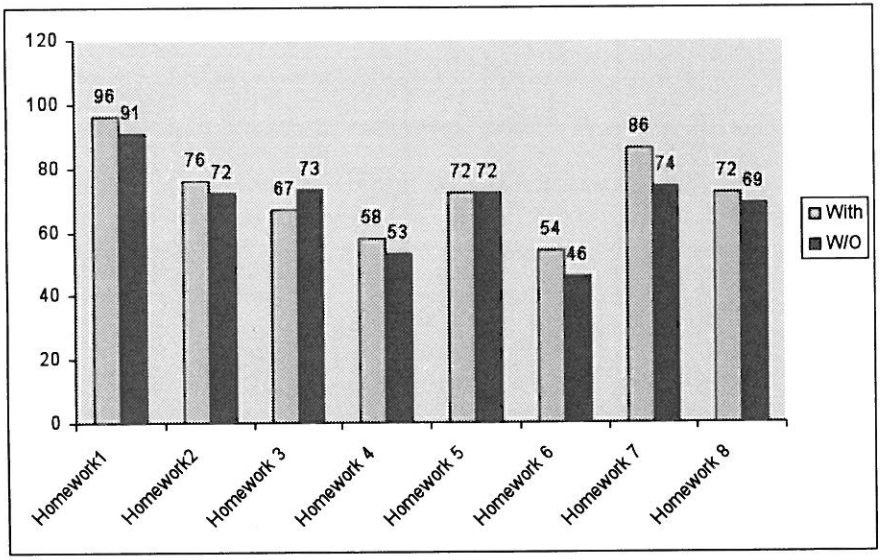


***Figure 2.*** Comparison of Homeworks Grade Means.

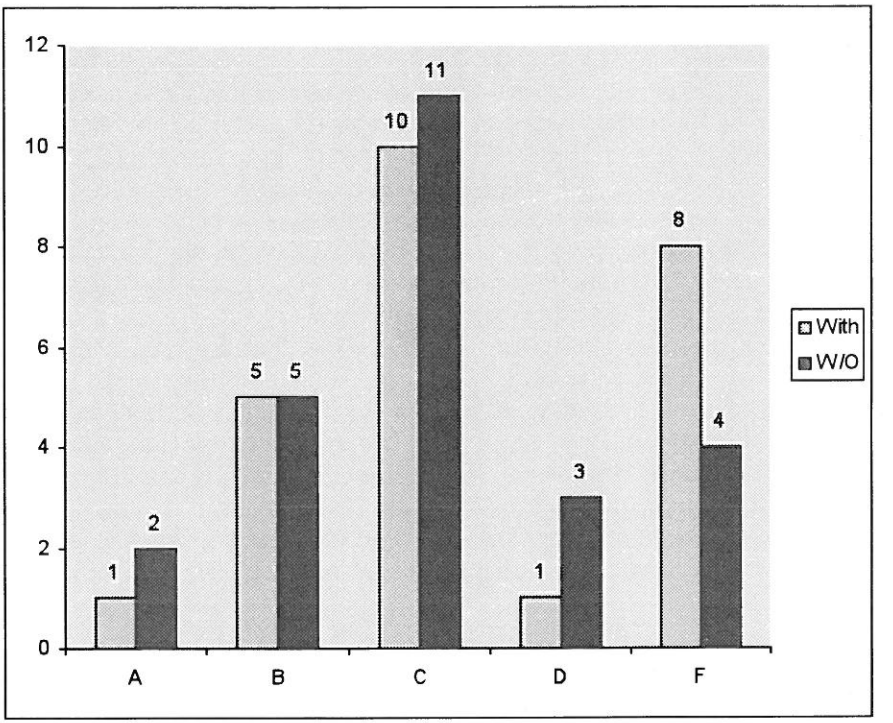


***Figure 3.*** Distributions of Course Grades

## DISCUSSION

The pretest data were used for two significant reasons. The first reason is to allow for the assumption that the control and experimental groups are "equal", even in the absence of random assignment. Because the classes are intact, random assignment of students was not possible. The pre-test means on the control and experimental groups were, respectively, 25 with a standard deviation of 9 and 28 with a standard deviation of 8. The t-test revealed that the pre-test means were not statistically significantly different. The variability in the standard deviations of the two groups is similar. There is slightly more variability in the class with the required SI. The second reason is to show the gains from the pretest to the post test for students within each group.

In looking at the overall performance of the two classes, the following information came from the data. On the tests in these two classes, the class without the required SI performed better than or equal to the class with the required SI on 6 of the 7 tests. So, the test performance is mixed. On the homework assignments, the class with the required SI performed better than or equal to the class without the required SI on 7 of the 8 homework assignments. This is interesting because a portion of the SI was geared for homework help with the instructor. It does follow that with the instructor the SI class had

higher homework scores. It is somewhat unnerving that this performance was not reflected in the test scores. In fact, it was just the opposite.

The data showed that students who received the required supplemental instruction (SI) did not perform better than students who did not receive the required SI. This may suggest that SI was unsuccessful. However, trends in the data show that the class without required SI had a higher pre-test score. It was not significant, but still higher. This could imply that the class without required SI had stronger students. These students may have felt that they did not need the extra class to help them through College Algebra and so they did not enroll in the experimental course. Consequently, the class without required SI had a higher post-test score as well.

From the professor's point of view, I feel that the class with the lab benefited from the extra help. I think some of the students would not have performed as well as they did without supplementary instruction. This is rather difficult to show or prove, but I became very close and familiar with the students in the class with the lab. It is my professional opinion that some of the students in the class with the lab benefited from the supplemental instruction. The lab required more time on task and the venue to ask more questions and receive more help if the students took advantage of it.

## CONCLUSIONS/FUTURE RESEARCH

The purpose of this research was to determine if requiring SI in a College Algebra course would benefit the students' performance in the course. It is understood that several factors come into play when dealing with college students' academic performance. However, this study only chose to focus on the students who enrolled in the course and what those students did specifically in the course. Other factors are present obviously, but out of the control of this quasi-experiment.These findings are consistent with Lazari and Simons (2003).

Recommendations for future studies include controlling numerous factors that influence student achievement in college algebra. These factors include student "type" (age, race, gender, major); previous academic performance as measured by high school grade point average and SAT scores; and involvement of students in campus activities. Finally, a qualitative analysis of the professor's and students' perceptions of supplemental instruction will also provide valuable insight into the effective of supplementary instruction for promoting student achievement in college algebra.

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